Application of Specimen Bank Resources to Investigate Tributyltin in the Alaskan Arctic Marine Ecosystem

Among the different compounds in formulations of antifouling paint, tributyltin (TBT) is the most active and toxic. TBT is known to be an endocrine disruptor at very low concentrations in some marine animals. Biological impacts have been reported in confined environments such as harbors or industrialized bays. An ultra-sensitive analytical method for the determination of TBT and its two metabolites (mono- and dibutyltin) was used for analysis of cryogenically archived specimens from NIST's Marine Environmental Specimen Bank (Marine ESB). These results are the first report of the presence of this class of compounds in the Arctic marine environment.

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Use of tributyltin (TBT) in antifouling paint began in the 1950s. TBT-based paints were widely used until 1988, when they were banned for use on all boats less than 25 meters long. Tankers and cargo-type vessels are still allowed to use this class of paints, although a complete ban is proposed for 2008. The presence of TBT and its two metabolites (monobutyltin [MBT] and dibutyltin [DBT]) has been reported in several species of marine mammals and pelagic fish throughout the world, thus suggesting a global contamination pattern for this class of compounds.

An ultra-sensitive analytical method recently developed at NIST was used to analyze samples from the Marine Environmental Specimen Bank at the Hollings Marine Laboratory to determine if TBT, DBT, and MBT can be detected in the Arctic marine environment.

This method, speciated isotope dilution-gas chromatography-inductively coupled plasma mass spectrometry (SID-GC/ICP-MS), was developed to quantify medium to trace concentrations of butyltins in cryogenically homogenized natural biological materials. Analyses of the banked samples documents, for the first time, background concentration levels of butyltin species in different compartments of the Arctic marine ecosystem. The spatial distribution of butyltins was investigated using banked murre eggs (*Uria aalge* and *U. lomvia*) collected in Alaska by the Seabird Tissue Archival and Monitoring Project (STAMP). Temporal trends were investigated by analyzing ringed seal (*Phoca hispida*) and beluga whale (*Delphinapterus leucas*) liver samples collected over a 10-yeard period near Barrow, Alaska, and banked by the Alaska Marine Mammal Tissue Archival Project (AMMTAP).

Butyltin species were found in the majority of the samples analyzed. The analysis of more recent samples (1999) compared to older samples (1988) revealed recent exposure to butyltins even 10 years after the initiation of environmental regulations.

Cryogenically stored samples are best for butyltin impact studies because degradation of thermolabile species is minimized.

Tissue samples from upper trophic level Arctic species, such as murres and beluga whales, are particularly appropriate for monitoring butyltin compounds.

Photos: NMFS National Marine Mammal Laboratory

The main source of TBT in this region is unknown. One possibility is that it could be related to shipping traffic activity, mainly characterized by cargo transits and ice-breaker activity for which no regulation of TBT antifouling paints is in place. However one should be cautious when considering sources because very little is known regarding the physiochemical behavior of these compounds in the environment, transport mechanisms, and the role of biota in their transformation and transfer through the food webs.

Future Plans: Additional analyses will be performed on more recently collected samples (2002) to further evaluate the temporal trends.